

# PRK Complications

# Classification

- Early (<6 weeks)
- Early or Late
- Late (>6 weeks)
- Refractive
- Miscellaneous

# Early

- Pain
- Sterile infiltrates
- Immune cells
- Infectious keratitis
- Delayed epithelialization
- Contact lens-related issues
- Pseudodendrites



# Pain

- Intensity variable
  - FBS, “sand,” “eyelash”
  - “Broken contact lens”
  - “Knives, rocks, bricks”
  - Ache
  - “Broken bottle filled with suntan lotion”
- Related to epithelial defect
- Lasts 24-48 hours
- Treatment
  - Topical NSAIDS
  - Topical Tetracaine
  - Cooled Celluvisc
  - TSCL
  - Oral pain medication
  - Cool compresses

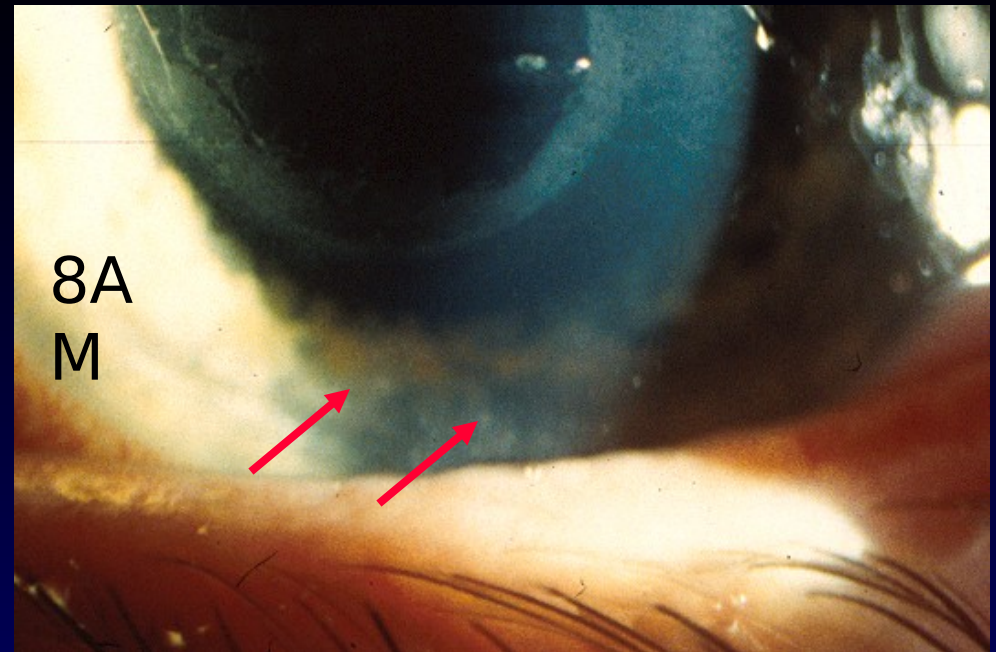
# Sterile Infiltrates

- Frequency 1:300-1:500
- Focal opacities
- Usually multiple
- Associated with immune cells
- May be outside ablation zone
- Be wary for true infectious keratitis
- Treatment
  - Stop NSAIDS
  - Start or increase steroids
  - Antibiotic coverage
  - Monitor closely
  - Very low threshold to culture

# USAF PRK Study

## Sterile Infiltrates

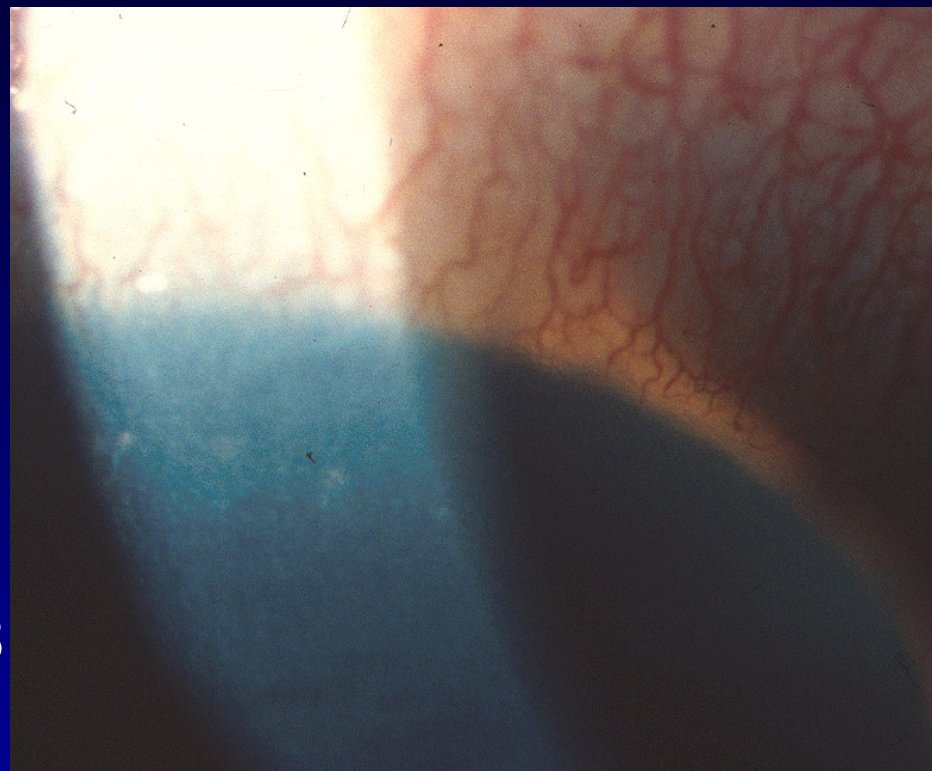
- 2 of 139 eyes (2%)
- Onset POD1 in both eyes
- Different patients
- Both eyes had concurrent immune cells
- Resolution by POD7 for both eyes
- One eye lost CL before POD1 exam



# USAF PRK Study

## Stromal Immune Cells

- Present in 47% (40/86) eyes for which data collected
- Onset (eyes):
  - POD1 32% (13/40)
  - POD2 38% (15/40)
  - POD3 28% (11/40)
  - POD4 0 (0/40)
  - POD7 2% (1/40)
- Duration > 7 days: 17% (6/35)



# USAF PRK Study

## Stromal Immune Cell Location

- Peripheral cornea **95%** (38/40)
  - Superior quadrant alone 71% (27/38)
  - Superior quadrant +/- other quadrants **92%** (35/38)
  - Other quadrants alone 8% (3/38)
  - All quadrants (360 degrees) 5% (2/38)
- Central cornea 2% (1/40)
- Complete cornea 2% (1/40)



# Infectious Keratitis

- Frequency unknown
  - Corneal infiltrate
  - Overlying epithelial defect
  - Usually unifocal, can be multiple
  - Often within the ablation zone
- Treatment
    - Culture
    - Some recommend topical ofloxacin or ciprofloxacin q hour if small lesion
    - Consider fortified antibiotics q hour
      - › Cefazolin 50mg/ml
      - › Tobramycin 15mg/ml
    - Consider cycloplegia



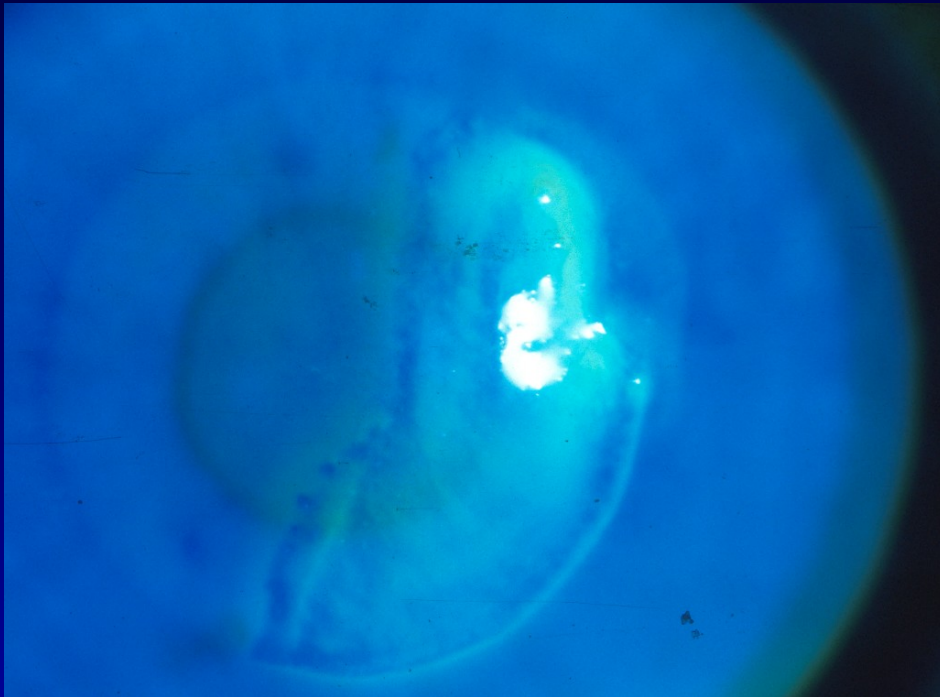
# USAF PRK Study

## Infectious Keratitis

- Culture positive
  - 0% (0/139) eyes
- Presumed (culture negative)
  - 1 eye (1/139; 0.72%)
    - › Onset POD3, 0.3 mm, outside ablation zone
    - › Fortified antibiotics
    - › Resolved in 24 hours
    - › At 6 months: UCVA 20/13, BCVA 20/10

# Delayed Epithelialization n (>4days)

- Frequency 0-2%



- Associated with
  - Early TSCL removal
  - Poor TSCL fit
  - Debris under TSCL
  - Epithelial flap
  - Patient predisposition (ocular surface or systemic)
- Treatment
  - Add or exchange TSCL
  - Increase lubrication
  - Continue antibiotic
  - Stop NSAIDS
  - Punctal occlusion
  - Consider topical anesthetic abuse, HSV, infectious keratitis

# USAF PRK Study

## Epithelialization

- 100% of eyes epithelialized by day 4 (n=139)
- Time to epithelialization (eyes)
  - 1 day            0        (0/139)
  - 2 days           45% (63/139)
  - 3 days           53% (73/139)
  - 4 days           2%    (3/139)
  - *Mean*            *2.6 days* (139/139)
- Delayed epithelialization > 4 days: 0%

# USAF PRK Study

## Contact Lens (CL) -Related Issues

- 100% of eyes given CL day of surgery
- Time to CL removal (eyes):
  - 1 day            0        (0/135)
  - 2 days           33%   (45/135)
  - 3 days           62%   (84/135)
  - 4 days           4%    (5/135)
  - 5 days           1%    (1/135)
  - *Mean*            *2.7 days*   (135/135)

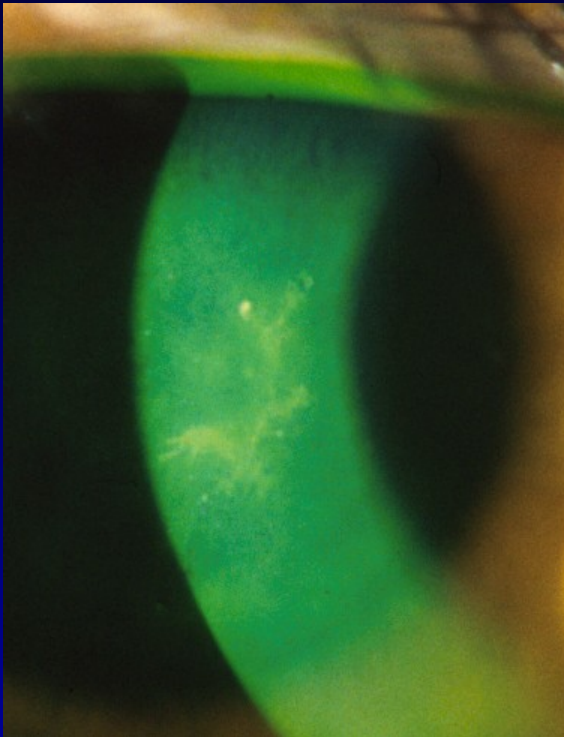
# USAF PRK Study

## Contact Lens (CL) -Related Issues

- 11.1% (15/139) of eyes lost a CL
- 3% (4/139) eyes required CL replacement POD1-2 for better fit
- 4% (6/139) developed recurrent epithelial defect following CL removal
  - 7% (3/45) eyes with CL removed POD2
  - 4% (3/84) eyes with CL removed POD3

# Pseudodendrites

- Common in 1st week
- Normal healing response
- Treatment
  - Observation
  - No change in medications
- Consider HSV if
  - occurs after epithelium has healed
  - is associated with intraocular inflammation



# Early or Late

- Ocular hypertension
- Loss of BCVA
- Halos
- Central islands
- Decentration
- Recurrent corneal erosion



# Ocular Hypertension

- $Ta > 25$
- Topical steroid-related
- 30% population steroid responsive
- 0.8-32\*% post PRK
- IOP monitoring essential (monthly)
- Treatment
  - Timolol (Timoptic)
  - Brimonidine (Alphagan)
  - Dorzolamide (Trusopt)
  - Neptazane
  - Acetazolamide (Diamox)
- Do not independently stop steroids

*\*8-10mm rise*

# USAF PRK Study

## Ocular hypertension ( $Ta \geq 25$ mm)

- 14% of eyes (19/139)
  - 11 patients, 19 eyes
  - 3 patients had unilateral OHT only
- Onset: week 2-8, mean 4.5
- Range of intraocular pressure: 25-38 mm, mean 29
- Treatment
  - None 0% (0/19)
  - 1 agent 74% (14/19)
  - 2 agents 16% (3/19)
  - 3 agents 5% (1/19)
- Resolution off steroids in all eyes



# Loss of BCVA

- Usually early
- Uncommon late
- Causes
  - Epithelial irregularity
  - Haze
  - Irregular astigmatism
  - Central islands
  - Decentered ablation
  - Non-PRK cause
- Evaluation
  - Full eye exam
    - › R/O retinal pathology
  - Topography
  - HCL overrefraction
  - PAM
  - Treat underlying cause as needed

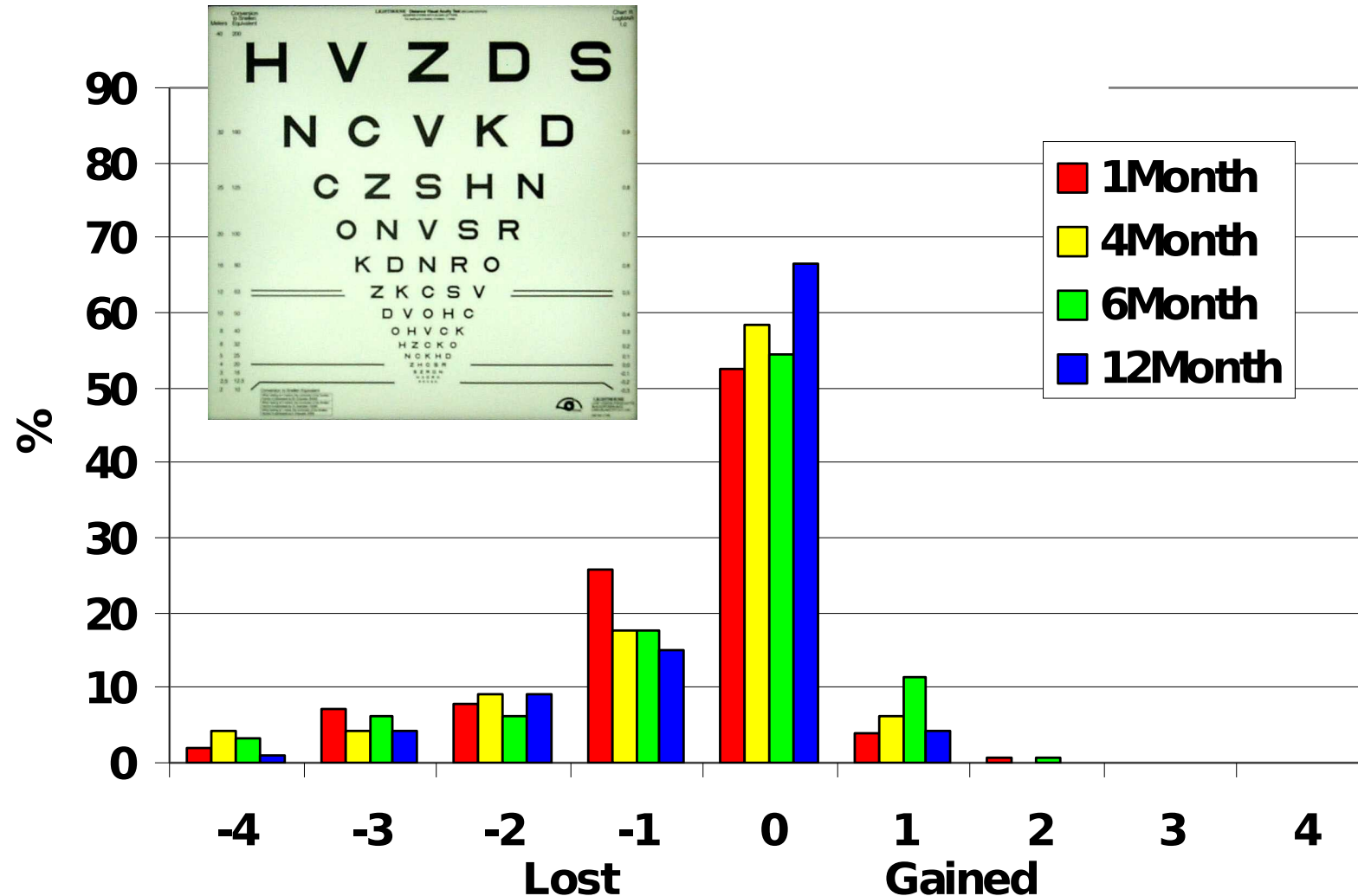
# USAF PRK Study: BCVA Lines Lost (%)

Lines Lost	1Month	4Month	6Month	12Month	24Month
-4	0.0	0.0	0.0	0.0	0.0
-3	0.7	0.0	0.0	0.0	0.0
-2	2.6	0.7	1.4	0.0	0.0
-1	13.2	6.3	4.1	5.0	2.4
0	75.0	80.3	68.7	74.8	66.7
1	7.9	12.7	24.5	18.5	28.6
2	0.7	0.0	1.4	1.7	2.4
3	0.0	0.0	0.0	0.0	0.0
4	0.0	0.0	0.0	0.0	0.0
Total%	100.0	100.0	100.0	100.0	100.0
n	152	142	147	119	42

*\* Line lost at 24 months was 20/12 to 20/15*

# USAF PRK Study: UCVA vs. BSCVA

## Lines Lost and Gained, ETDRS



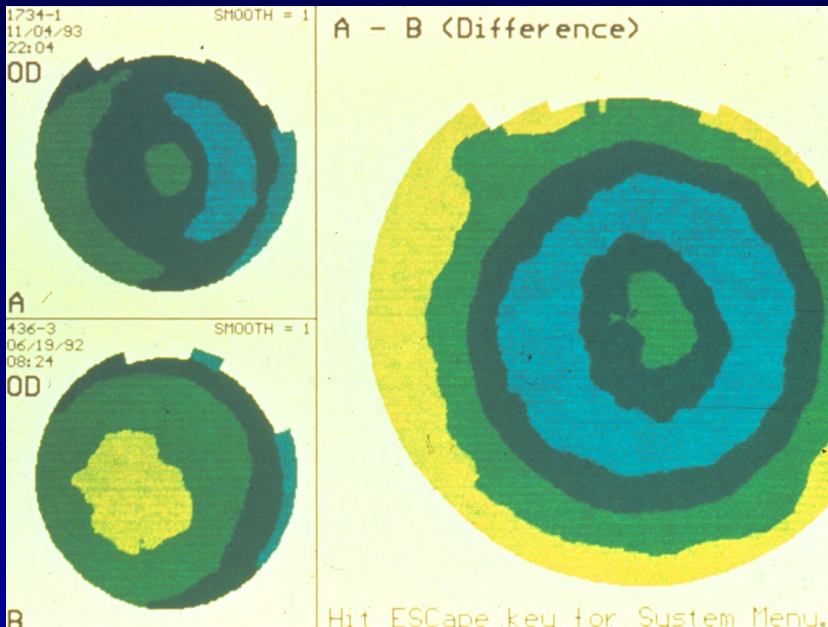
# Halos

- Common early
- Uncommon late
- Causes
  - Epithelial abnormalities
  - Residual refractive error
  - Large pupil
  - Central islands
  - Decentered ablation
  - Astigmatic ablations
- Treatment
  - Depend on cause
  - Improve/ resolve in most patients with time
  - If pupil related consider
    - › Dapiprazole
    - › Pilocarpine (careful)

# Central Islands

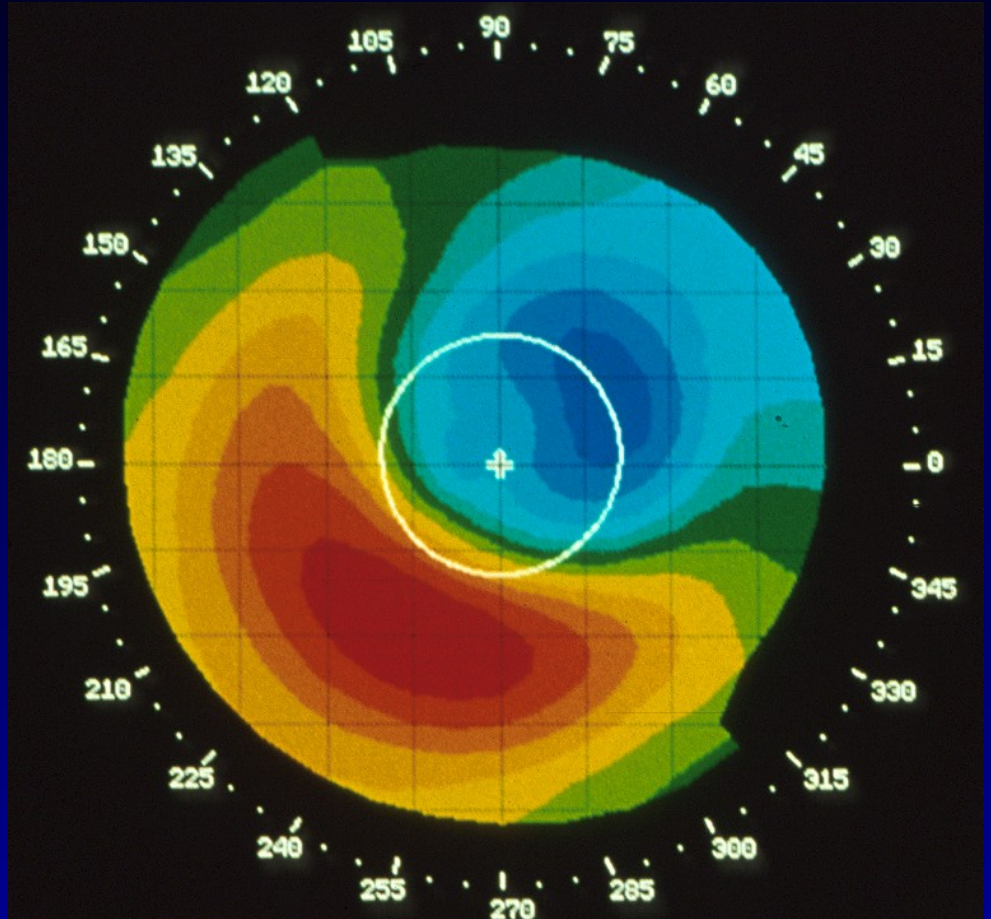
- Central elevation by SUBTRACTION MAP
- No uniform definition
- Uncommon

- Causes
  - Fluid wave
  - Plume obstruction
  - Laser optics
  - Epithelial hyperplasia
  - Other
- Treatment
  - Most resolve in time
  - PTK



# Decentered Ablation

- Decentration of  $> 1\text{mm}$  by SUBTRACTION MAP *at 1 month*
- Asymmetric healing can make centered ablation appear decentered
- Loss of BCVA, glare, halos, diplopia, etc..



EyeSys



# Decentered Ablation

- Causes
  - Laser misalignment
  - Poor patient fixation
  - Surgical decentration
  - Movement/  
misalignment during  
videokeratography

*Miotics decenter pupil*

- Treatment
  - Several
    - › Retreatment with equal and opposite decentration
    - › Occlusive masks
    - › Others
  - None ideal
  - Await future technology
    - › Custom ablations
    - › Wavefront ablations

# Recurrent Erosion

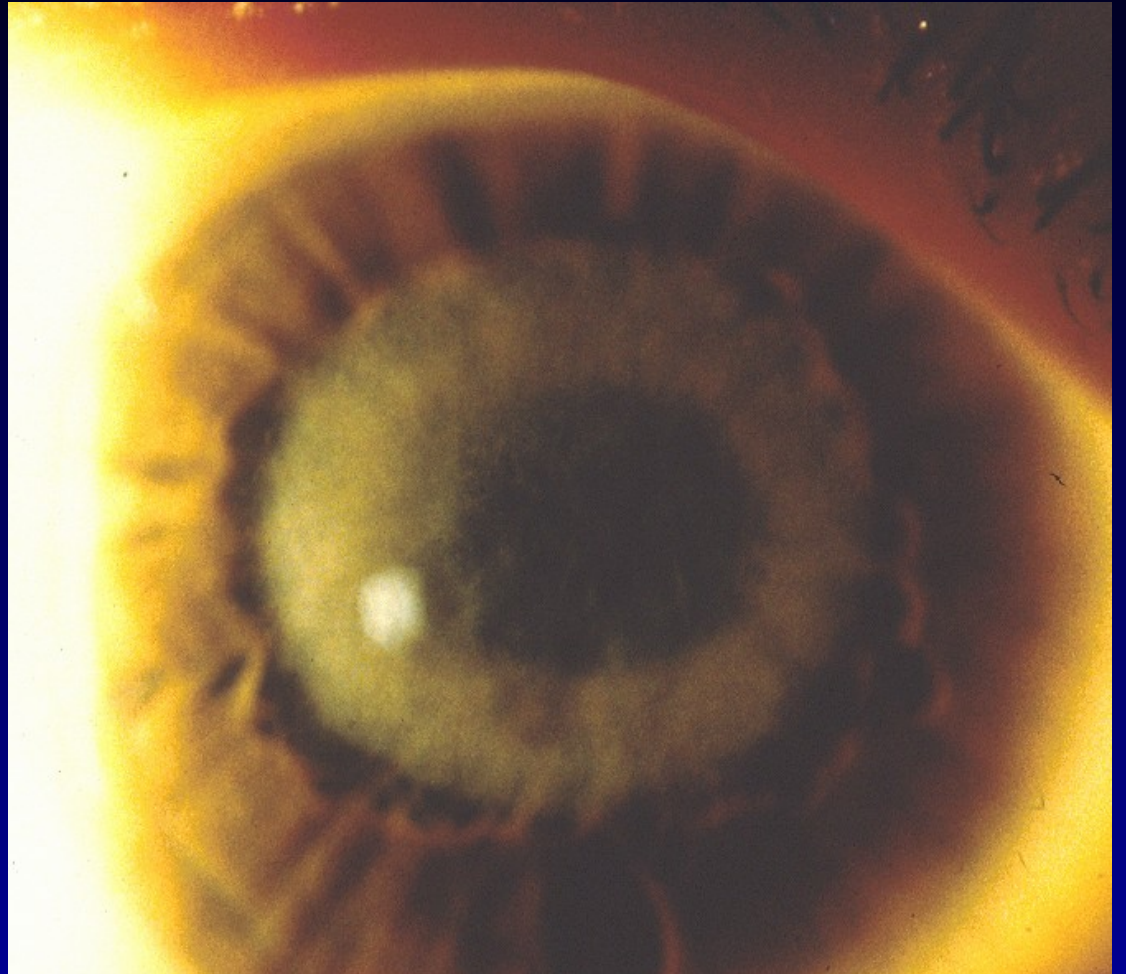
- Pain, FBS, tearing
  - Decreased vision
  - Usually upon awakening
  - Epithelial defect or microcysts
  - Rare after PRK
  - Likely due to underlying predisposition and outside ablation zone
- Treatment
    - Antibiotics until epithelialized
    - Lubricants
    - TSCL
    - Hypertonic saline
    - PTK/ PRK
    - Stromal puncture

# Subjective Dry Eyes

- Common early
- Uncommon late
- Treatment
  - Lubricants
  - Punctal occlusion
  - Manage blepharitis

# Late

- Haze
  - Early onset
  - Late onset  
corneal haze  
(LOCH)

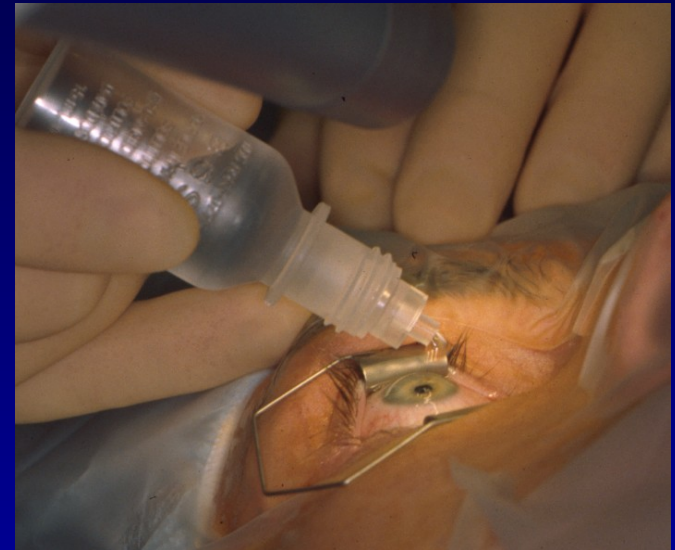


# Haze

- Early onset occurs in 1st 3-6 months, then typically resolves
- LOCH occurs 4-33 months post-op
- Most asymptomatic
- Can have loss of BCVA, visual symptoms
- Central haze may be associated with regression
- Peripheral haze may be associated with astigmatism or overcorrection

# Haze

- Potential causes
  - UVB exposure
  - Deeper ablations
  - Laser beam homogeneity
  - Epithelial removal technique
  - K sicca
  - Keloid formation (?)
  - Rapid steroid taper (?)
- Prevention
  - Patient selection
  - Cold BSS irrigation
  - Sunglasses



# Haze Grading

Stein, The Excimer: Fundamentals and Clinical Use,  
SLACK, 1997

- **Trace:** trace of faint haze by indirect broad oblique illumination
- **Mild:** discrete haze visible with difficulty by direct focal slit examination. More granular and confluent than trace.
- **Moderate:** moderately dense corneal opacity that obscures iris detail in direct illumination
- **Severe:** a severely dense opacity that completely obscures iris detail

# Haze Grading

McDonald *et al.*, *Ophthalmology* 1991;98:1327

- 0: clear cornea
- Trace: barely perceptible haze apparent only to trained observer
- 1.0: mild reticular haze not affecting refraction
- 2.0: moderate haze, refraction possible but difficult
- 3.0: opacity prevents refraction, anterior chamber easily viewed
- 4.0: opacity impairs view of anterior chamber and iris detail
- 5.0: totally opaque scar, anterior chamber not visible



# Haze Grading

Braunstein *et al.*, *Ophthalmology* 1996;103:439

- 0: clear, no haze
- 0.5: haze, barely detectable
- 1.0: mild, not affecting refraction
- 1.5: haze mildly affecting refraction
- 2.0: moderate haze, refraction possible but difficult
- 3.0: opacity prevents refraction, anterior chamber easily viewed
- 4.0: opacity impairs view of anterior chamber
- 5.0: unable to see anterior chamber

# USAF PRK Study

- **Early Onset Haze:** ( $\geq 2+$ ,  $<6$  months)
  - Moderate, refraction difficult
  - 0% (0/139) eyes
- **Late Onset Corneal Haze:** (any,  $>6$  months)
  - 6.6% (5/76) eyes
    - › worst UCVA 20/20
    - › worst BCVA 20/15

# Haze Treatment

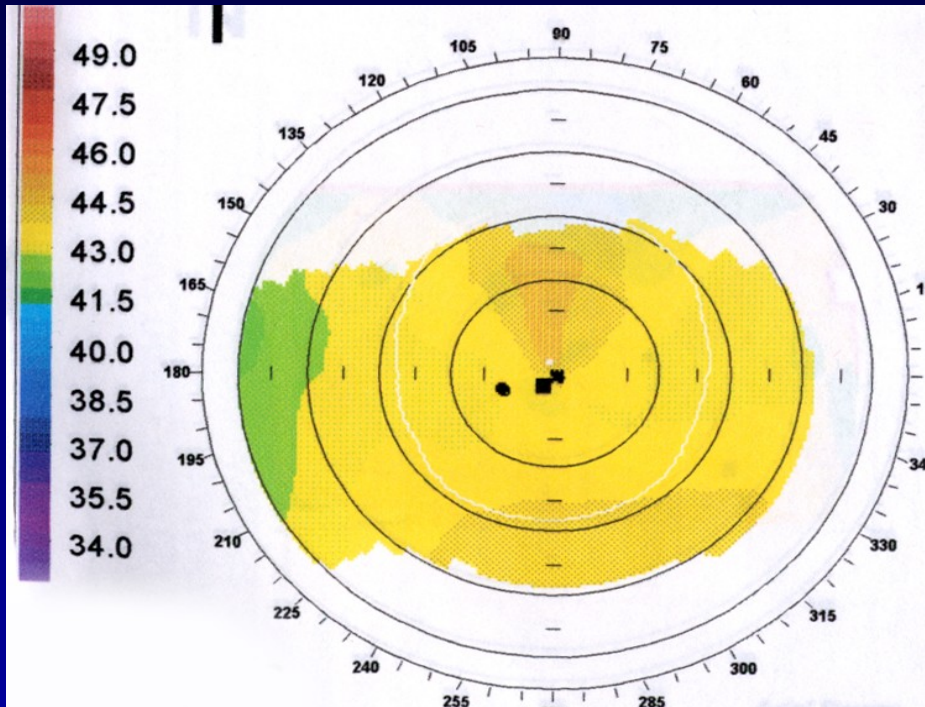
- Early Haze
  - Ensure patient following prescribed steroid taper
  - Observation
- LOCH
  - Observation
  - Topical steroids
  - PTK
  - MMC

***MOST HAZE RESOLVES WITH TIME***

# PATIENT: PRK OU 4/01

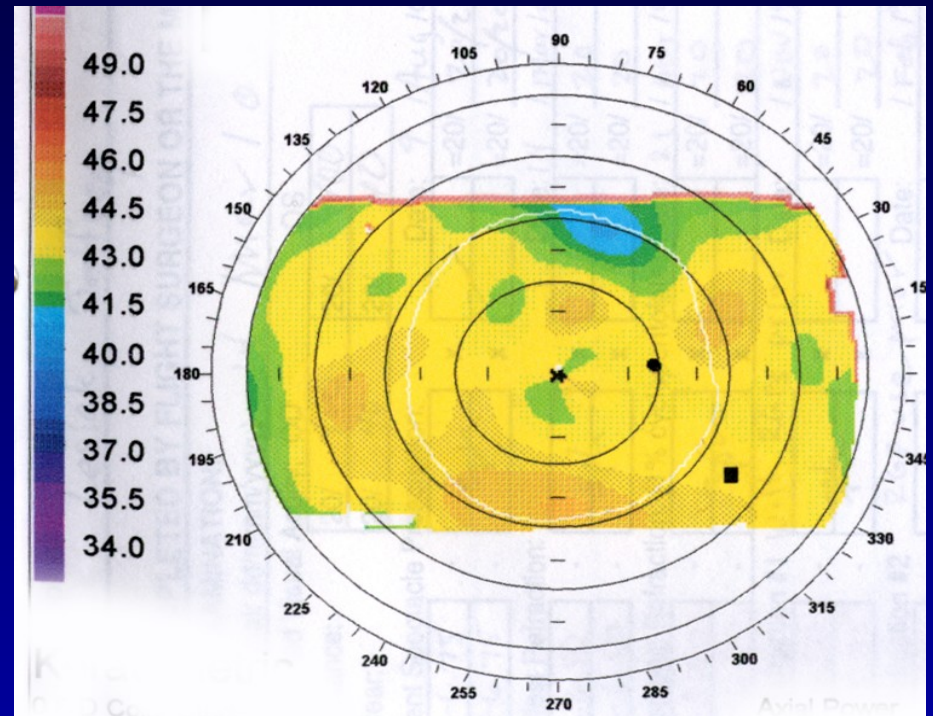
## OD

- -6.50 OD
- Orbscan Pach 565
- VISX S2
- Laser scrape
- Tx depth 80



## OS

- -6.75
- Orbscan Pach 570
- VISX S2
- Laser scrape
- Tx depth 80



# Postop Course

- **1 Week:** UCVA 20/20 OU
  - $-0.25 + 0.25 \times 108$
  - $-0.50 + 0.75 \times 066$
- **1 Month:** UCVA 20/20; 20/25
  - $PI + 0.50 \times 070$  (20/20)
  - $+0.50 + 0.25 \times 66$  (20/20)
- **2 Months:** UCVA 20/20 OU
  - $PI + 0.25 \times 068$  (20/20+)
  - $+0.50 + 0.75 \times 038$  (20/15)
- **3 Months:** UCVA Missed

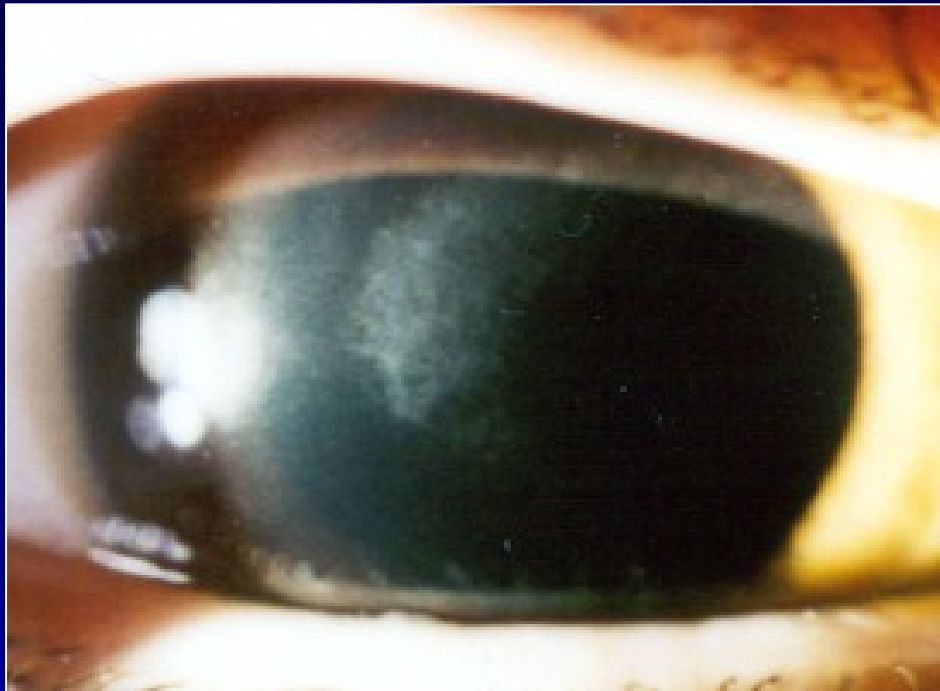
# Postop Course

- **4 Months:** UCVA 20/20 OU
  - Plano OU (20/20 OU)
  - Faint peripheral haze OU
- **7 Months:** UCVA 20/20 OU
  - -0.50 OU (20/20)
  - Grade 3 haze OU
- **7.5 Months:** UCVA 20/20 OU
  - Plano (20/20) Grade 1 haze
  - Pl -0.75 x 80 (20/20) Grade 2 haze

# PRK OU 10 Months

## OD

- UCVA 20/30
- BCVA 20/16
- Cyc + 0.50 + 0.50 x 045
- Orbscan Pach 355

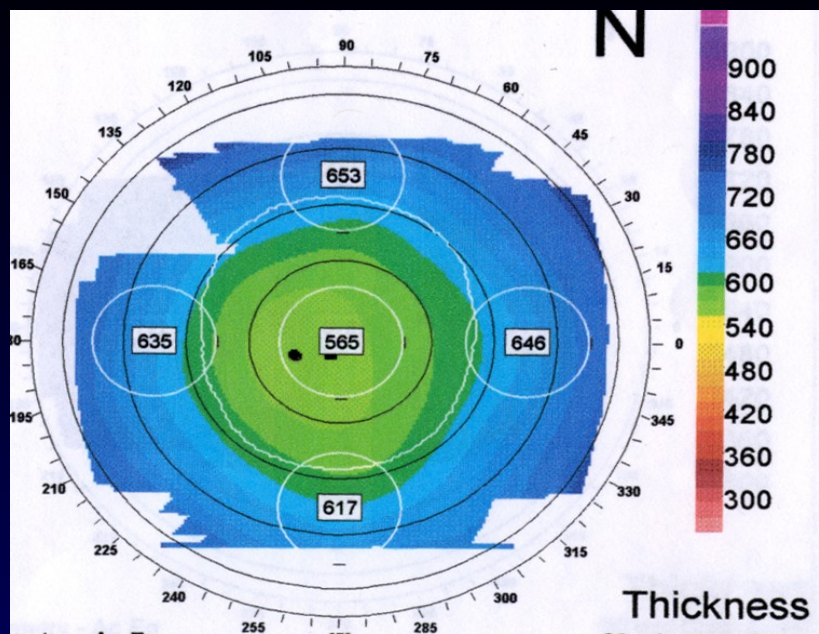


## OS

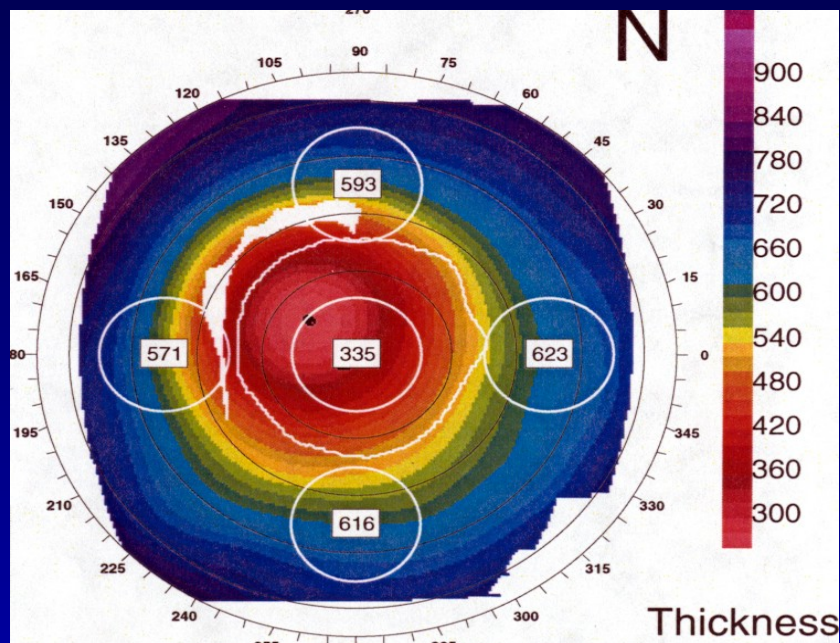
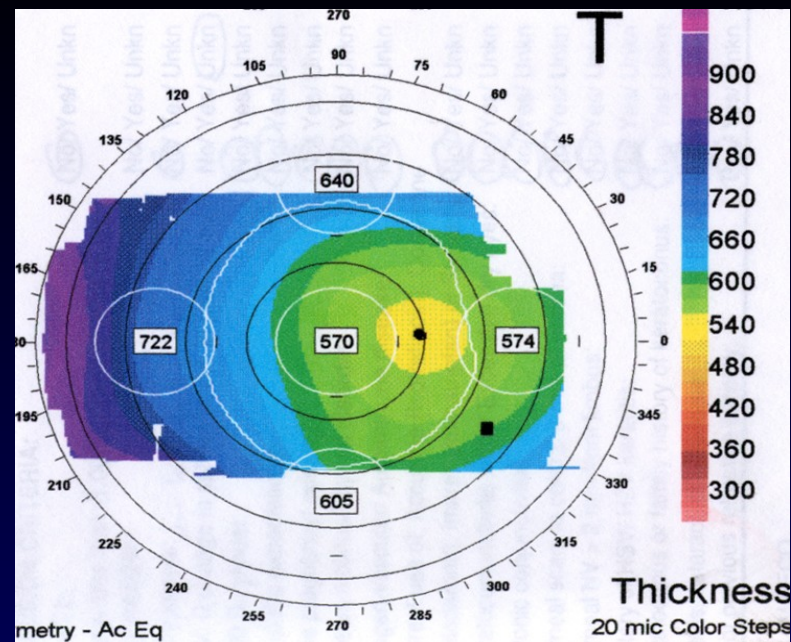
- UCVA 20/200
- BCVA 20/28
- Cyc -2.50 + 0.25 x 050
- Orbscan Pach 277



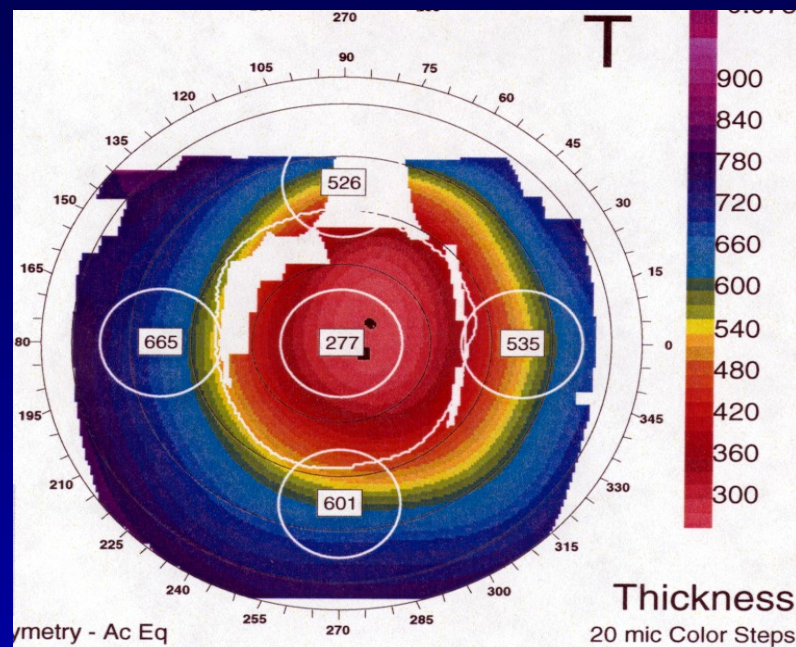




10  
Months



DGH  
498

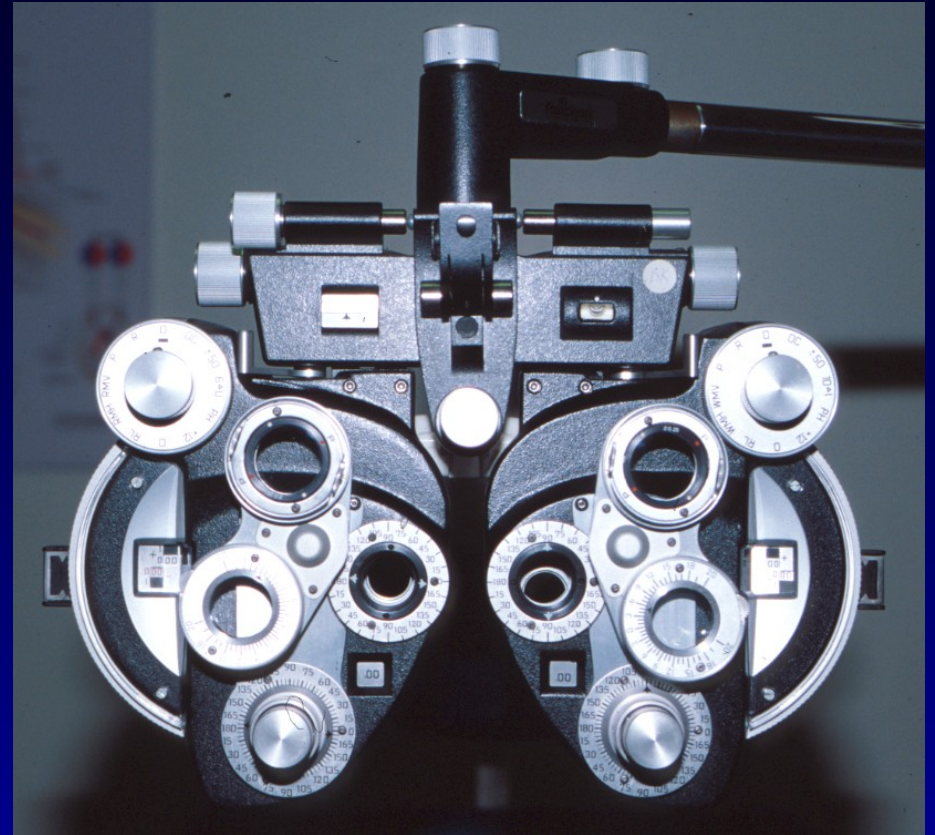


DGH  
498

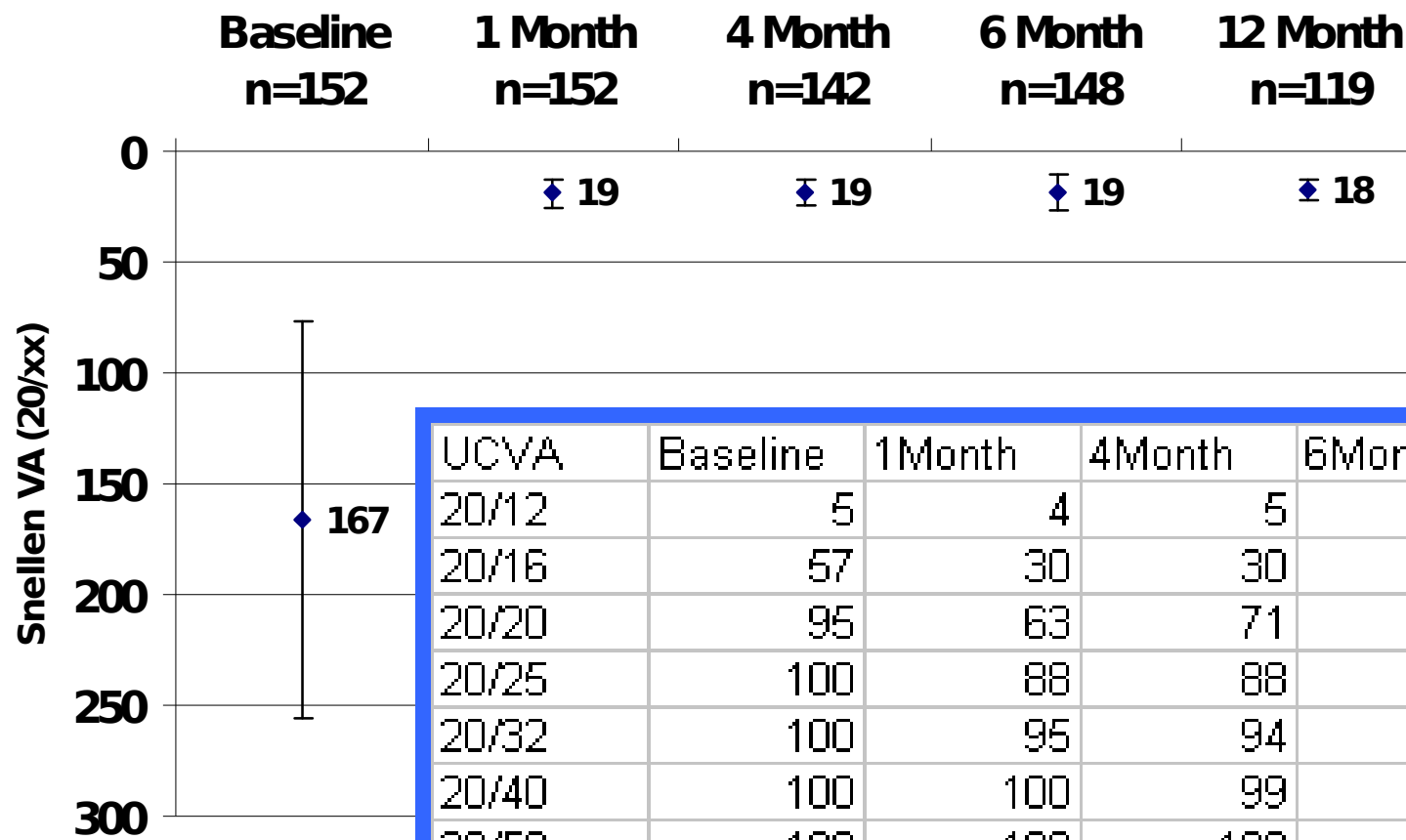


# Refractive

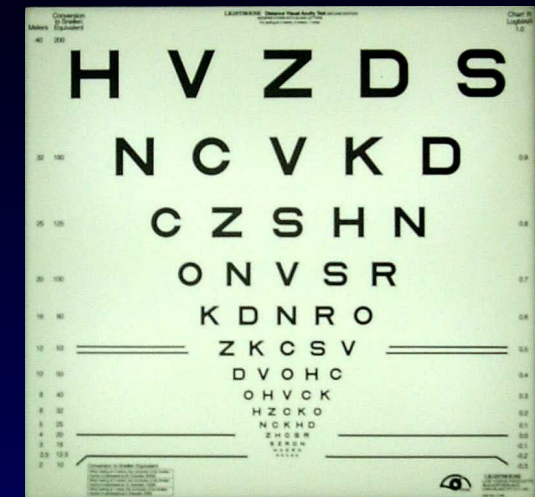
- Level of UCVA
- Primary Undercorrection
- Overcorrection
- Presbyopia
- Regression



# USAF PRK Study: UCVA, ETDRS

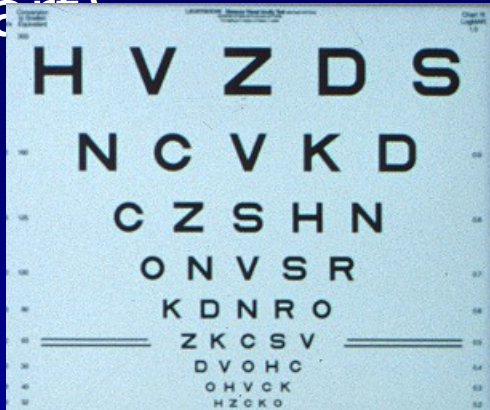


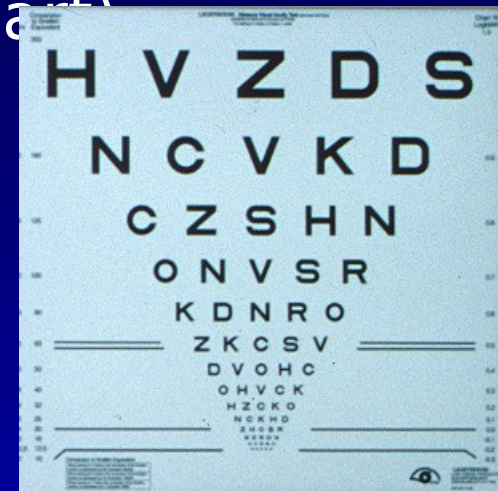
UCVA	Baseline	1Month	4Month	6Month	12Month	24Month
20/12	5	4	5	6	7	19
20/16	57	30	30	37	33	50
20/20	95	63	71	72	71	88
20/25	100	88	88	87	95	100
20/32	100	95	94	96	99	100
20/40	100	100	99	97	100	100
20/50	100	100	100	98	100	100



n (24 mos) =  
42

# Undercorrection

- >1 D deviation from intended correction at 3-6 mos post-op
  - Compare cycloplegic refractions
  - Haze increases refractive myopia and refractive uncertainty
  - Causes
    - Undertreatment
    - Wet cornea
    - Aggressive healer
    - Rapid steroid taper
    - Haze
- ## Treatment
- Some myopia is good for peri-presbyopes
  - Consider retreatment
  - Ensure refractive stability ( $\pm 0.5$  D over 3 refractions, 1 mo apart)
- 



# Overcorrection

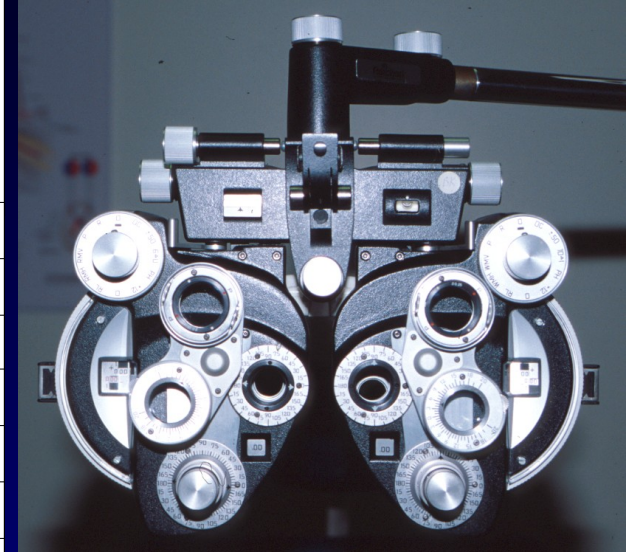
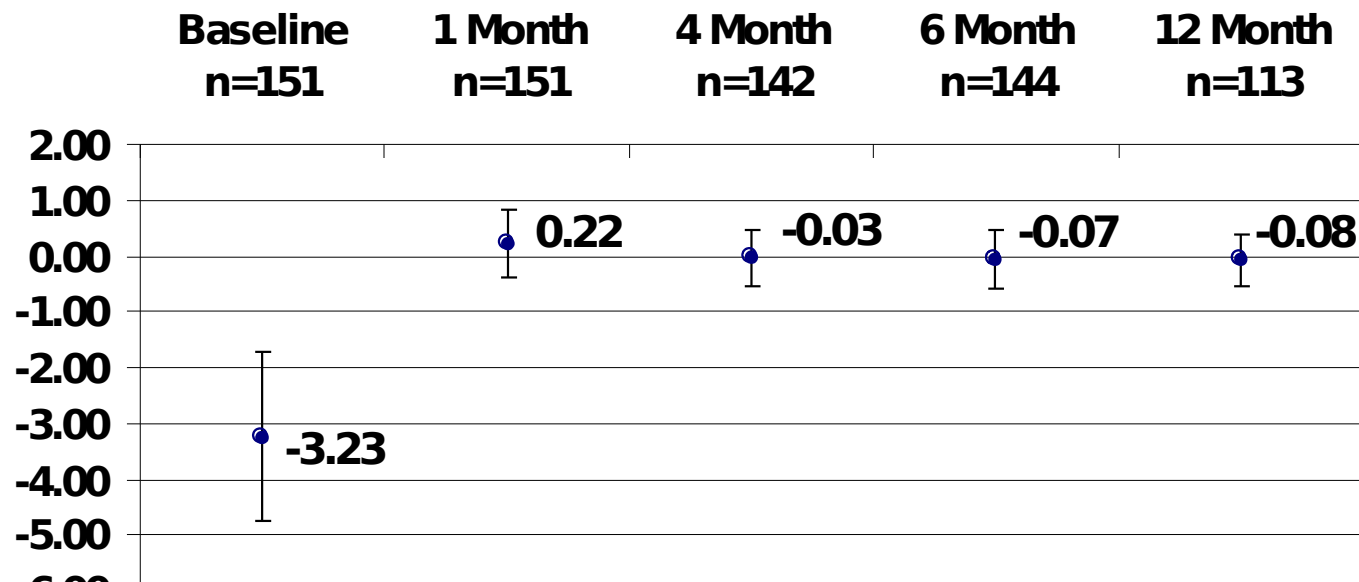
- Common early
- Expect about 0.5 D myopic shift in first 6 mos
- Causes
  - Poor pre-op cycloplegic refraction
  - Incorrect treatment parameters
  - Dry cornea during treatment
  - Thin epithelium post-op



# Overcorrection

- Treatment
  - If persists after 1 month, hasten steroid taper, monitor closely for haze
  - Lubricants
  - TSCL
  - Epithelial debridement
  - Hyperopic PRK when stable

# USAF PRK Study: Cycloplegic Refraction



n (24 mos)= 40

	1 Month	4 Months	6 Months	12 Months	24 Months
+/- 0.25	38.4%	46.5%	47.9%	54.0%	62.5%
+/- 0.5	64.9%	73.9%	72.2%	77.0%	87.5%
+/- 1.0	90.7%	97.9%	95.1%	98.2%	100.0%
+/-2.0	100.0%	100.0%	100.0%	100.0%	100.0%

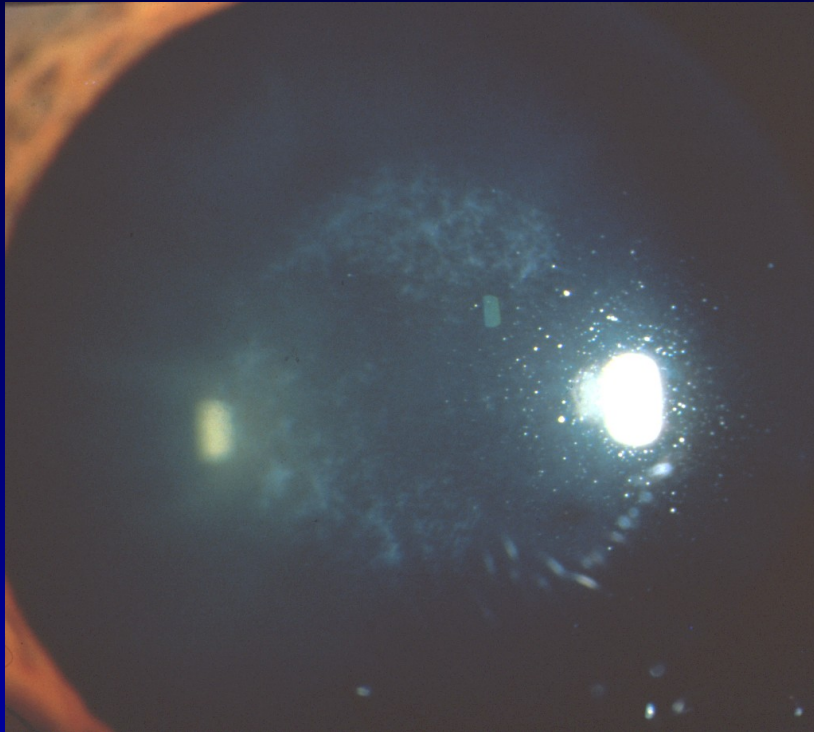
# Presbyopia

- NO MATTER HOW MANY TIMES PRE-PRESBYOPES ARE TOLD ABOUT THE POTENTIAL FOR READING GLASSES POST-OP, MANY DO NOT (OR CHOOSE NOT TO) UNDERSTAND
- *“I didn’t realize that I wouldn’t be able to read the can labels at the grocery store”*
- Emphasize, describe, and document preoperatively



# Regression

- > 1 Diopter deviation from intended correction at > 6 mos post-op
- May be associated with haze



- Risk factors
  - UV exposure (OR 7.7\*)
  - Rapid steroid taper
  - Steep wound edges
  - High myopia
  - Small optical zones
  - BCP (OR 13.5\*)

\*Corbett *et al*,  
*Ophthalmology* 103:1381



# Regression

- Treatment

- Prednisolone acetate 1% qid for 2 weeks
  - › If refraction responsive, taper slowly (q 2 mos)
  - › If refraction not responsive, taper rapidly, monitor for haze, consider retreatment

- Retreatment

- Only when refraction stable ( $\pm 0.5$  D over 3 refractions, one month apart)

# Miscellaneous Issues

# Pregnancy

- Issues
  - Unreliable refractions
  - Dry eyes
  - Medication toxicity
- USAF PRK Study
  - Pregnancy: 1.4% (1/71)
    - › 3 mos post second eye
    - › Removed from study
    - › UCVA 20/20 OU (24mos OD and 21mos OS)
    - › No haze

# Eye Sensitivity

- Tenderness
- Photophobia
- Rare
- Typically resolve in time

# USAF PRK Study

## Miscellaneous Complications

- Basement membrane changes: **5%** (7/139 eyes)
- Aborted treatment: **0.72%** (1/139 eyes)
- Nausea from anisometropia requiring prochlorperazine (Compazine): **0.72%** (1/139 eyes)

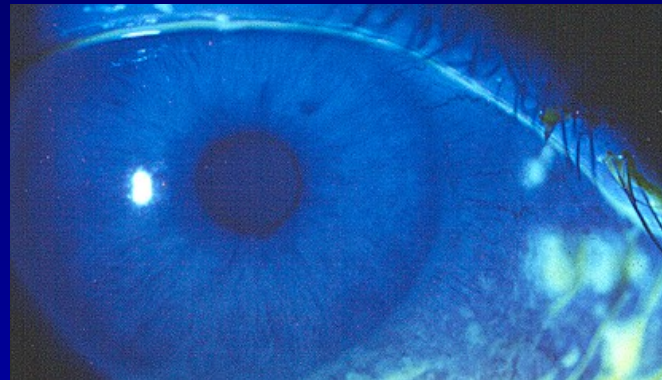
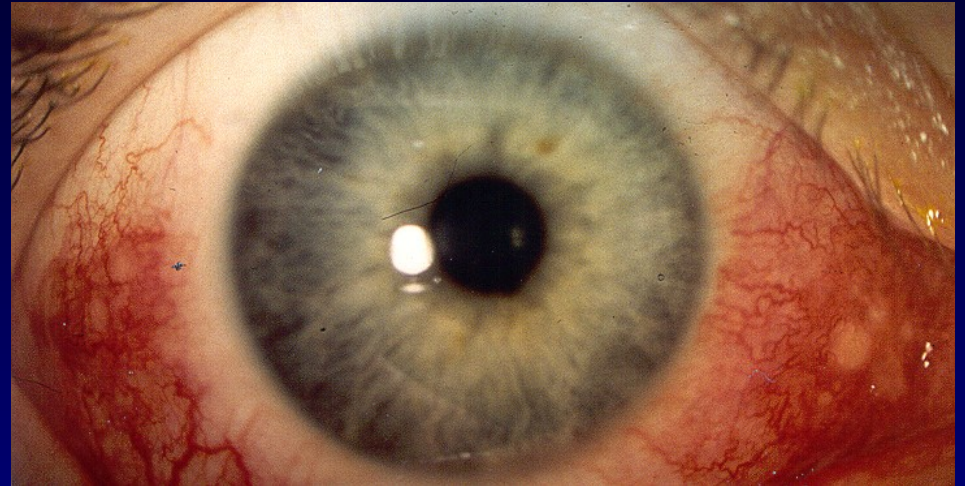
# USAF PRK Study

## Miscellaneous Events

- Ocular trauma: **7.2%** (9/139 eyes)
  - 1 eye, 2 mos post op, haze trauma site
  - 1 eye, traumatic iritis
  - 3 eyes, 2 patients, corneal abrasions from tonopen
- Follicular conjunctivitis: **6.5%** (9/139 eyes)
  - 5 patients, 5 -12 months post-op
- Peripapillary hemorrhage: **0.72%** (1/139 eyes)
  - 5 mos post-op
- Scleritis and/or episcleritis: **2.2%** (3/139 eyes)

# ZM

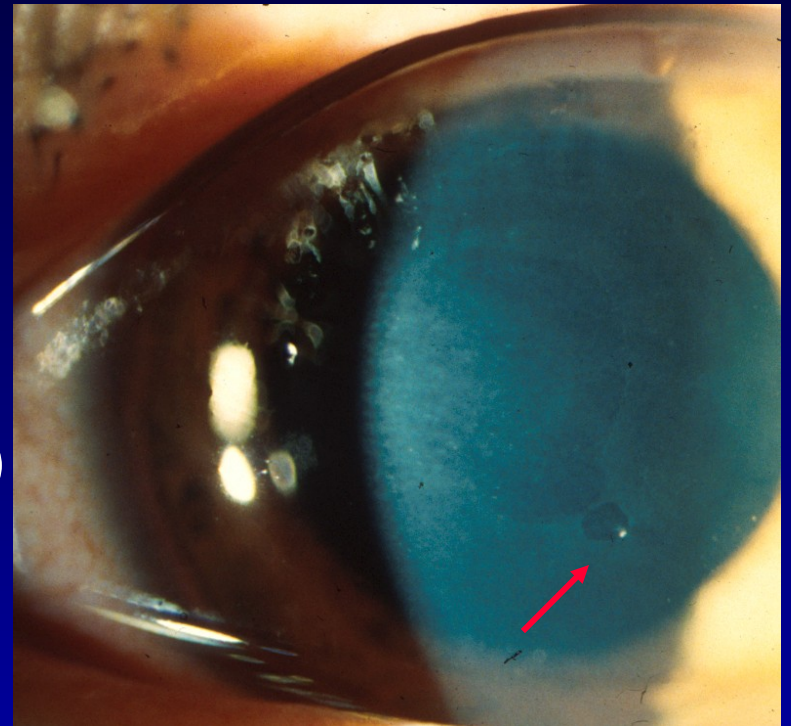
- 24 y/o M
- 6 mos post PRK OU
- Ulcerative follicular conjunctivitis
- Episcleritis
- Peripheral K infiltrates
- Hematuria
- Neck rash
- *Bartonella henselae* 1:64 (+)
- *Bartonella quintana* 1:128 (+)



# USAF PRK Study

## Additional Procedures

- Debride epithelial flap: **2.2%** (3/139)
- Remove foreign body from under CL:  
**2.2%** (3/139)
  - Merocel sponge fragment
  - Fiber
  - Thread
- Retreatment: **1.4%** (2/139)





# USAF PRK Study SUMMARY

## USAF      Other

Delayed epithelialization ( $> 4$ days)	0%	2%
Contact lens-related issues	14.1%	?
Immune subepithelial infiltrates	2%	0.3-0.4%
Infectious keratitis	0.7%cases	
Ocular hypertension ( $Ta \geq 25$ mm)	14%	0.8-32%*
Haze ( $\geq 2+$ )	0%	0-6.7%
Late onset corneal haze	6.6%cases	

\*  $>8-10$ mm elevation

# USAF PRK Study SUMMARY

	USAF	Other
Loss $\geq$ 2 lines BCVA ( <i>at 12 mos</i> )	0%	0-7%
UCVA < 20/20 ( <i>at 12 mos</i> )	24%	0-56%
UCVA < 20/40 ( <i>at 12 mos</i> )	0%	0-25%
Under or overcorrection ( <i>&gt;1 diopter, 12 mos</i> )	0%	3-28%
Retreatment	1.4%	0-37%